

## BRISTOL BAY ASSESSMENT PUBLIC COMMENTS

### Summary for Peer Reviewers

This document provides a brief overview and summary of the public comments received by the U.S. Environmental Protection Agency (EPA) during the public comment period for its draft assessment entitled *An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska* (hereafter, the Assessment). This summary focuses particularly on those comments addressing scientific or technical aspects of the draft Assessment. It was prepared by EPA staff for Versar, Inc., solely to assist the Bristol Bay scientific peer reviewers in preparation of their reviews of the Assessment. It is not meant to be comprehensive or detailed, and is not intended to provide any analysis of or commentary on the comments provided. A few clarifying notes by the EPA are presented in square brackets, but no attempt was made to systematically address the issues raised.

All of the public comments received on the draft Assessment are publically available on regulations.gov, under docket number EPA-HQ-ORD-2012-0276. Peer reviewers also will be able to access the public comments directly via a dedicated FTP site; instructions on how to access this site will be provided by Saturday, August 4 at 5:00 PM ET. In addition, transcripts from eight public meetings held by the EPA in Seattle, Anchorage, and throughout the Bristol Bay region are accessible via regulations.gov and will be placed on the FTP site. Further detail on any of the issues outlined in this summary can be found in these letters and public transcripts, and the EPA encourages peer reviewers to consult these resources as needed.

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### Overview of Public Comments

The EPA received over 220,000 public comment letters on the draft Assessment. This total includes approximately 5,500 unique letters and approximately 215,000 letters from twenty-five different mass mailing campaigns. Nineteen of these mass mailing campaigns, generating approximately 209,000 letters, expressed support for the Assessment and/or EPA action. Five campaigns, generating approximately 5,400 letters, were not supportive of the Assessment and/or EPA action. The remaining mass mailer, signed by 318 people, requested a comment period extension.

The comments received reflected a wide variety of viewpoints both supportive and critical of the Assessment. The vast majority of comments supported the conclusions of the Assessment and noted that the science demonstrates that a large-scale hardrock mine in the Bristol Bay watershed would jeopardize the salmon fishery the region supports. Other commenters stated that the Assessment is scientifically deficient and does not support that conclusion, and that large-scale mining can occur in the Bristol Bay watershed without significantly damaging existing salmon populations.

Many commenters who generally endorsed the conclusions of the Assessment felt it has underestimated the risk and impacts associated with large-scale mining in the Bristol Bay

region. Commenters expressed a desire to expand the scope of the Assessment, for example by including impacts of related development and effects on additional species. A more detailed list of suggested scope expansions can be found below, particularly in the Chapter 3 section. Other commenters suggested additional scientific information that should be incorporated into the Assessment, including studies on seismic hazards and environmental impacts at other mines.

Commenters who stated that the Assessment is scientifically deficient criticized it for considering the potential impacts of a hypothetical mine scenario, rather than a proposed mine plan, and for overestimating the risks and impacts associated with that scenario. In designing the hypothetical mine, some commenters stated that the Assessment does not rely on the most current practices and ignores existing standards and regulatory requirements for the design of tailings dams, waste rock piles, water treatment and management plans, road and culvert design, pipelines, and mine closure activities. These comments stressed that the mine permitting process would require avoidance, minimization, and mitigation of impacts, and that the Assessment should reflect potential benefits of these mitigation and remediation activities and be consistent with current practice and regulatory requirements. Commenters also requested that the EPA expand its consideration of the Environmental Baseline Data collected by the Pebble Limited Partnership, noting that it is a significant data source that is under represented in the Assessment.

### **Non-Technical Comments**

Although non-technical comments are not the focus of this summary document, general consideration of these comments is informative—largely because most of the comments received did not focus on technical issues raised by the draft Assessment. In this section, we provide a brief overview of some of the common non-technical issues raised in the public comments.

Many commenters focused on the importance of a functioning ecosystem, and particularly a robust salmon fishery, to the region, in terms of subsistence use, Alaska Native culture, commercial and recreational fisheries, and tourism. Other commenters stressed the potential economic benefits of mine development to this economically depressed region.

Nearly all commenters discussed Section 404(c) of the Clean Water Act and EPA’s authority to restrict, prohibit, deny, or withdraw the use of an area as a disposal site for dredged or fill material, if the discharge will have an unacceptable, adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas. A majority of commenters urged EPA to proactively use this authority to protect the Bristol Bay watershed by pursuing a 404(c) veto, given the conclusions of the Assessment and the ecological and cultural resources of the Bristol Bay region. However, other commenters stated that the Assessment does not support such an action, and that EPA should defer any regulatory decision until a permit application for a specific mine project has been submitted and a thorough study of potential impacts has been completed,

as part of an Environmental Impact Statement required under the National Environmental Policy Act.

## Summary of Comments Organized by Assessment Chapter or Appendix

This section provides a summary of the technical, scientifically substantive public comments received on the EPA's draft Bristol Bay Assessment, organized by the relevant chapter or appendix of the Assessment. Comments related to other aspects of the draft Assessment, such as potential regulatory actions, are not included in this summary, but can be viewed via [regulations.gov](https://www.regulations.gov) or the FTP site.

### **Chapter 1. Introduction/General**

- Issues concerning use of the Pebble Limited Partnership's (PLP's) Environmental Baseline Document (EBD)
  - Data from the EBD should not be used because its methods are invalid and species are misidentified.
  - More data from the EBD should be incorporated throughout the Assessment.
    - Assessment cites EBD 71 times, but it is highly unlikely that all available information in the 27,000 page EBD was incorporated.
- Issues concerning the Assessment and established methodologies and guidelines
  - Assessment is not an ecological risk assessment because it does not follow EPA's 1998 risk assessment guidelines.
  - Assessment inappropriately used EPA's 1998 risk assessment guidelines, which are more appropriate for smaller-scale studies with identified sources, pathways and receptors in a clearly defined area.
  - Assessment was developed using no clear or established methodologies.
  - Ecological risk assessment approach is inappropriate without baseline data and actual mine design parameters.
- General data and information quality issues
  - Much of the assessment fails to meet the requirements of the Federal Data Quality Act, because assumptions were made regarding impacts that are not supported by existing literature.
  - Data used in assessment are not representative, complete, or current.
  - ADF&G has many additional sources of fisheries data that were readily available but not considered.
  - Citation issues
    - Assessment should provide more citations.

- Assessment uses outdated references.
- Assessment demonstrates selective bias in the data and information used.
- Other general issues
  - Assessment is too general and speculative, not detailed enough, and does not present results scientifically.
  - Assessment lacks knowledge of the mining industry and Alaska’s permitting and regulatory framework.
  - Assessment provides contradictory and conflicting information.
    - For example, conclusions in the Executive Summary (ES) are not supported by the body of the document (e.g., ES states probability of failure of collection and treatment systems is high, but Chap 6 says can’t be estimated from the data and highly uncertain).
  - Assessment is scientifically sound and provides reasonable assessment of risks posed by large-scale hardrock mining in the Bristol Bay watershed.
  - Environmental and habitat impacts have been grossly overstated.
  - Assessment focuses on mine failures rather than mine successes.
  - Qualitative assessment ratings are not clearly defined, including the use of “significant” and “highly likely”.
  - Consideration of subsistence values should be more thoroughly and prominently discussed throughout the Assessment, given that subsistence resources and activities play an invaluable role in Alaska Native cultures.
  - The Pebble project should not be used as a surrogate for other mining operations in the Bristol Bay watershed, as it is not the largest and has different deposits.
  - Although the assessment underestimates the risks from mine operation, the estimated risks exceed those in all prior 404(c) actions.

## **Chapter 2. Characterization of Current Condition**

- Fish resources
  - Assessment appropriately characterizes importance of the Bristol Bay fishery (economically, ecologically, and culturally).
  - Detailed discussion of salmon life history and ecology is missing from the Assessment. Do not simply cite the appendices.

- Extent of anadromy for Dolly Varden and rainbow trout is poorly understood for the region and should be better characterized in the Assessment.
  - Naknek River sockeye are included in the numbers of fish from the Kvichak River, but the Naknek is not part of the study area; thus, including those fish overstates production in the Kvichak River.
  - Lake and beach spawning should not be mentioned because it does not occur on the Pebble site (with the possible exception of Big Wiggly Lake).
  - The importance of Bristol Bay salmon relative to global stocks should not be mentioned.
  - Salmon stocks are influenced by management rather than by habitat.
  - The evaluation of risk throughout the document needs to be expanded to include all salmon species and life stages.
  - The productivity of streams near the Pebble deposit is exaggerated, and should be compared to all other streams in the Bristol Bay watershed.
  - Marine-derived nutrients are not important on the Pebble site.
  - Assessment’s estimates of marine-derived nutrients in returning salmon are incorrect.
  - General statements from the literature about the influence of groundwater on salmon habitat should not be used unless they have been demonstrated at the Pebble site.
- Alaska Native cultures
    - Assessment should discuss that commercial fishing no longer provides enough money to supplement a subsistence way of life, and additional employment is needed (also included under Appendix D).
    - Assessment should discuss that population is not stable: the Lake and Peninsula Borough has lost over 18% of its population since the 2000 census, and schools have been lost in Ivanof Bay and Pedro Bay due to low enrollment (also included under Appendix D).
  - Other resources
    - Terrestrial bird fauna are adequately described,
    - Marine and coastal bird fauna are inadequately described, and Assessment should discuss Bristol Bay’s globally significant bird habitats
    - EPA’s conclusions on vegetation are sound because they are supported by sources of information other than PLP’s EBD.

- Other general issues
  - Assessment should stress that water in the region far exceeds virtually all of the State of Alaska’s water quality standards, increasing the likelihood that aquatic life will be highly susceptible to increases in metal concentrations.
  - Assessment should provide a more defensible and objective characterization of baseline conditions, including how indigenous resource systems often play important roles in the biocomplexity and stability of ecosystems.
  - Pebble EBD studies are not cited a single time in this chapter, although they provide in-depth studies of current conditions.
  - Assessment needs to do better job of explaining and presenting the portfolio effect and aspects of salmon quality and diversity.
  - The analysis of habitat complexity in the Wood, Nushagak, and Kvichak River watersheds is not applicable to the assessment because it does not address the Pebble site in particular.
  - The stability of river flows in Bristol Bay should not be compared to those in other salmon-producing areas.
  - Rivers that merge in their estuarine reaches should not be considered to have a common watershed.

### **Chapter 3. Problem Formulation**

- Scope of the Assessment should be expanded to include:
  - Secondary development
  - Electrical generation
  - Block caving
  - Blasting (as source of nitrate and ammonia)
  - Dust production
  - Chemical spills
  - Fuel spills
  - Tailings pipeline spills
  - Waste rock slides
  - Climate change
  - Noise pollution

- Port at Cook Inlet and associated facilities
  - Direct effects of mining on human health
  - Direct effects of mining on wildlife (including freshwater seals in Iliamna Lake)
  - Entire Bristol Bay watershed, including marine areas
  - Impacts to drinking water sources within the Nushagak and Kvichak River watersheds
  - Risks to all Alaskans (not just Alaska Natives), including those engaged in commercial, personal use, sport, and subsistence fisheries and hunting
  - Socio-economic impacts
  - Effects on all important fish species (including black fish that inhabit swampy marshland around Iliamna Lake)
  - Invasive species issues (e.g., invasive plants)
  - All mining prospects in the Bristol Bay watershed
  - Potential benefits of mine development to human health, safety, welfare, and the environment
- Other issues
    - Assessment uses an inconsistent scale and scope of the project area (Bristol Bay, the Nushagak and Kvichak River Watersheds, the tributary headwaters at the Pebble site, the Pebble site itself), and fails to address or quantify potential impacts as they relate to the various scales (e.g., should put length of stream lost in context of the entire watershed).
    - Assessment fails to address or quantify potential impacts as they relate to the various scales.
    - Assessment should state that it is necessarily incomplete because it is bounded by the scope of its mandate.
    - Fraser River should not be used as an analogous watershed.
    - Not all pathways shown in the conceptual models are analyzed in the Assessment.
    - Not all relevant pathways are included in the conceptual models.
    - Rainbow trout should be considered as salmon, since they are in the same genus.



- Consider cultural ties to area fisheries resulting from multi-generational use by commercial, sport, and non-Native subsistence fishers.

#### **Chapter 4. Mining Background and Scenario**

- Tailings storage facility (TSF) failure issues
  - Run-out from TSF failure should be modeled based on Rico et al. (2008), resulting in 38% of tailings spilled rather than the conservative 20% value.
  - The assumption that 20% of tailings could spill is too high.
  - Failure rates for historic dams should not be considered.
  - The assumption of a probable maximum flood is too extreme.
  - It is unreasonable to assume that sufficient freeboard to contain the probable maximum flood would not be maintained.
  - Probability of TSF failure is overestimated because estimates are based on historic failure rates.
  - Probability of TSF failure is underestimated because estimates are based on design specifications.
  - Any failed tailings dam would be repaired and remediation would be immediate, so impacts of failure are overestimated.
  - The only logical, albeit still unreasonable, full-volume TSF failure scenario is to have failure occur at the southern embankment.
  - The modeling results for the tailings spill scenario are incorrect, because the tailings could be deposited in the first 30 km given valley volume.
  - The Silva et al. method should not be applied to hypothetical dams.
  - Assessment's description of tailings particle size is inconsistent.
  - Tar sands tailings compaction is not proven to be similar to mine tailings compaction.
  - Assessment's assumption of a void ratio of 46% filled with unrecoverable water is within range of reported values in literature, but is likely to be inaccurate.
  - "Sloping" of bulk tailings has not been effective in preventing tailings release in other dam failures, since tailings often saturated long-term.
- Water budget and hydrology issues
  - Assessment's water budget is suspect, unreliable, and not realistic.

- The assessment seriously underestimates the amount of water that would require collection and treatment.
- The hydrologic water balance (Table 4-5) contains a gross error because it shows the same pore water volume during different periods [NOTE: commenter mistook a use rate ( $\text{m}^3/\text{yr}$ ) for the volume in use ( $\text{m}^3$ )].
- Assessment ignores the fact that hydrology depends on location characteristics.
- Figure 4-7 should not show streams that are not important to the endpoint fish species.
- Box 4-2 presents a brief and vague discussion of effects of the cone of depression, which should include discussion of mitigation.
- Assessment evaluates water flow and hydrologic impacts during average rather than low flows.
- Water quality and treatment issues
  - Assessment should discuss, at least in a general sense, possible types of water treatment needed and whether these types of treatment have been used at other mines with similar volumes of discharged water.
  - Discussion of tailings leachate chemistry in the Assessment does not seem to consider humidity cell test results from the one pyritic tailings humidity cell test sample.
  - It should not be assumed that acid generation would stop below the water level in the open pit after closure.
  - Assessment should include movement of contaminated mine water from the pit or underground workings to downgradient streams and groundwater.
  - Assessment should consider how other wastewaters (beyond mill waste tailings) could affect downstream water quality, for both no failure and failure modes.
  - Assessment should evaluate how natural stream waters will change from discharge of treated mine water under no failure mode (e.g., increase in water hardness and potential impacts, even if water quality standards are met).
  - Assessment should consider oxygenation of tailings by upwelling groundwater.
  - All major mines in Alaska operate with a mixing zone. If the EPA believes that the water from the mine can be treated to meet standards without a mixing zone it should cite a relevant case in which that was achieved.
  - The assessment does not adequately consider the need to collect and treat peak flows due to extreme events.

- The difficulty of adequately treating the discharge water from a pit lake to achieve water quality criteria at end-of-pipe is underestimated. In particular, the freezing conditions during 7/12 months are not considered.
- The assessment does not recognize the difficulty of capturing the leachate from tailings impoundments given the porous and fractured geology of the site.
- Seismicity issues
  - Assessment overstates the strength of current scientific knowledge of seismic risks in the area, implying that lack of evidence from past earthquakes is evidence that no such earthquakes have ever occurred.
  - Very little research has been done on seismic hazards in this region and the seismic hazard assessment presented in PLP's Environmental Baseline Document is flawed, so uncertainty is high.
  - There is not a high degree of uncertainty concerning the location and future activity of geological faults.
  - Assessment should emphasize the lack of evidence of recent faulting near the Pebble site and the expectation that a mine operator would mitigate against seismic risks.
  - Assessment fails to reference the most current and appropriate publication on the largest nearby fault, Koehler and Reger 2011.
  - Assessment's concern that earthquakes pose a potential danger is well-founded.
  - Assessment does not describe the general seismic environment of Bristol Bay and is missing the broader geological context of four independent and actively moving blocks of crusts and subduction.
  - The terminus and length of the Lake Clark fault have not been determined.
  - Assessment should describe the lack of effects at the Fort Knox tailings dam due to the 2002 earthquake on the Denali fault.
  - Quake proximity is equally important to magnitude in designing embankments. One located closer than that used in PLP's design assumptions (i.e., 18 miles from the site) could produce significantly more energy.
  - Provide more details concerning seismicity.
- Road and pipeline issues
  - Assessment's assumption of standard road and stream crossing designs is not sufficiently specific.
  - Road design and maintenance are not clear.

- Failures of the Trans Alaska Pipeline are not relevant because they were due to human failures in inspection and management.
- The volume of product spilled in a pipeline failure is overestimated, because shutdown would reduce flow rate.
- Assessment should mention that 15-20% of the proposed road already exists.
- Assessment does not adequately address potential mitigation for effects of roads due to sediment, salts, dust, and interference with surface and shallow groundwater flows.
- Construction of a road or pipeline should not be assumed.
- Oil and gas pipeline failures rates should not be considered.
- Modern culvert standards should be assumed.
- Modern mine roads do not inhibit fish passage.
- Include risks from bridges.
- Geological issues
  - Porphyry copper is not the major mineral resource type in the Nushagak and Kvichak watersheds
  - Assessment contains inadequate discussion of geology and hydrogeology of the Pebble area, especially in the pit and tailings storage facilities.
  - Assessment’s description of porphyry copper deposits is not relevant because each deposit is unique and some mineral deposits in the Bristol Bay watershed are not porphyry copper.
- Design, mitigation, remediation, and restoration issues
  - The document fails to address impact avoidance, minimization, or mitigation actions, thereby overstating potential impacts.
  - All of the failures considered in the Assessment can be avoided by proper design, so no failures should be assumed.
  - Effective mine closure measures ensure no contamination impacts downstream.
  - Assessment does not adequately consider the application of midwestern coal mine reclamation and other techniques for habitat mitigation post-closure.
  - Assessment should discuss that scientific literature documents that stream restoration has generally been unsuccessful.

- Assessment fails to address challenges and risks of mitigating stream and wetland losses.
- Assessment does not adequately address challenges of constructing and operating a failure-proof mine with respect to water treatment
- Assessment does not address challenges and feasibility of post-closure reclamation given scale and climate.
- It is unrealistic to consider any mine closure that does not include planned site management, given state reclamation bonding requirements.
- Assessment should include significant data on geomembrane service life that are available from mining and other industry or government sources.
- Alaska bonding requirements will assure perpetual monitoring and maintenance, and should be described in Assessment.
- A spillway would be installed after closure.
- Present or reference information such as permafrost distribution, slope, aspect, surficial materials stability, etc., for evaluation of impacts from roads, pipelines, failures, etc.
- The tailings and waste rock are likely to be hazardous materials that would require lined storage.
- The assessment does not adequately address the difficulty of reclaiming the waste rock piles and tailings impoundments including the availability of suitable cover to support revegetation.
- Block caving issues:
  - Address fact that block caving would fracture overlying strata, allowing water and oxygen infiltration into mine. After closure, such infiltration could lead to down-gradient contamination.
  - Address whether block caving would require dewatering similar to open pit mining.
  - Identify monitoring and other post-closure issues unique to underground mining.
- Assessment underestimates potential effects because:
  - Underestimates maximum size of potential mine (6.5 billion tonnes vs. 10.8-11.9 billion tonnes estimated).
  - Groundwater effects are highly uncertain

- Assessment assumes tailings storage facility and valley walls are impermeable and that seepage will follow current topography
- Does not consider how DO saturated water upwelling into tailings storage facilities can be alleviated.
- Does not consider cumulative impacts associated with build-out of a single mine, including power, port, transportation, other infrastructure development.
- Given performance record of existing mines, there is a significant chance that one or more of the failures evaluated will happen over the life of the mine.
- Uses National Wetlands Inventory, which vastly underestimates wetland extent.
- Uses Alaska NHD, which underestimates extent of streams.
- There is no evidence of any industry or society successfully collecting, pumping, and treating mine wastes for tens of thousands of years, as must be done here.
- Does not include all necessary components of mine footprint.
- Water balance underestimates volume of water needing treatment during operation and post-closure.
- Fails to account for extreme events (e.g., peak storm runoff).
- Fails to account for porous nature of surficial deposits and fractured bedrock under tailings impoundments.
- Fails to note that enormous wastewater discharges can only take place during 5 months of year when receiving waters are not frozen.
- Failure scenarios are too conservative, and should be revised to better reflect worst-case scenarios.
- Seepage collection systems are notoriously inefficient, if not ineffective, often resulting in long-term contamination of down-gradient waters.
- Assessment overestimates potential effects because:
  - Mine size is overestimated.
  - Deposition in Iliamna Lake would be less consequential than assumed.
  - Wet disposal of tailings behind a dam should not be assumed.

- Other issues

- The Assessment does not provide an accurate assessment of potential mine development impacts, because the hypothetical mine and scenarios are not the only options available in the Bristol Bay region.
- The assessment’s hypothetical mine scenario accurately represents the potential for mining in the Bristol Bay watershed.
- The copper concentrate would be alkaline and dissolved copper concentrations in the slurry would be low.
- The Pebble deposit is not located in the headwaters of the Nushagak and Kvichak Rivers, but the headwaters of tributary streams.
- The Gibraltar Mine in British Columbia has thriving populations of rainbow trout in both its active tailings pond and its seepage control and pump-back pond.
- Premature closure would not occur because it is against State policy.

#### **Chapter 5. Risk Assessment: No Failure**

- Because the size of the mine resource is underestimated, the assessment underestimates long-term risks to fish.
- Risks from contaminants are underestimated because:
  - Assumption that all water can be captured and properly treated to meet water quality criteria is spurious.
  - Laboratory toxicity tests for copper, and therefore State and Federal criteria, underestimate impacts to sensitive macroinvertebrates, algae, and olfaction-dependent behaviors in salmon (e.g., see McIntyre et al. 2012)
    - Most laboratory tests do not evaluate combination of low hardness and low dissolved organic carbon conditions seen in Bristol Bay headwater streams, which make biota even more sensitive to increased metal concentrations
    - Alaska and EPA copper standards are inadequate to protect aquatic life in study area, where increased metal concentrations will be toxic at very low levels.
  - Assessment should consider potential synergistic effects of mixtures (e.g., copper and zinc).
  - Truck traffic would be sufficient to make metals and oil significant stressors.
- Risks from contaminants are over-estimated because:

- Copper toxicity is exaggerated; it is an essential element and is homeostatically controlled
- A geologic analogue of Pebble near Williams Lake in British Columbia supports thriving populations of rainbow trout in both its *active* tailings pond and in its seepage pump-back pond.
- Risks from habitat loss or modification are underestimated because:
  - National Wetlands Inventory vastly underestimates wetland extent
  - Spot surveys of salmon may underestimate value of habitats at other times of year or under other conditions, thus underestimating importance of keeping these habitats connected
  - Effects are not dependent on the presence of salmon – changes in organic matter, invertebrates, and other fish species are critical to downstream salmon populations.
  - The ADEC temperature criterion of 13° C is underprotective of spawning and rearing Dolly Varden.
  - Salmon populations and habitats are underestimated
    - Table 5.1, which reports PLP data for salmon spawner index counts, is based on an invalid methodology used by Pebble contractors (both the maxima and minima are underestimates).
    - Extent of anadromous habitat is underestimated because streams were not randomly sampled and existing sample site representativeness was not assessed.
- Risks from habitat loss or modification are overestimated because:
  - Mitigation of filled or altered streams and wetlands should be included.
  - The State of Alaska’s data exaggerate the importance to salmon of streams near the Pebble deposit because presence may be interpreted as presence in abundance.
  - Many of the streams on the site are not ecologically functional and have poor habitat and water quality.
  - Water withdrawal would be mitigated.
  - Groundwater discharge should be considered as an alternative to surface water discharge.
  - Under a no failure scenario, water temperature would not be affected.



- The assumption that stream flows downstream of the mine footprint would be reduced in proportion to the area of watershed reduced is not supported.
- It should not be assumed that flow limits salmonid production because other unanalyzed factors also limit production.
- Reduced flow could increase habitat by reducing velocity.
- The mine footprint may not eliminate any streams or wetlands.
- A majority of the stream channels in the vicinity of the footprint of the mine do not have off-channel habitat.
- The Assessment fails to identify that food resources are a limiting factor to anadromous fish production in the mine footprint area.
- Specific foraging opportunities or important rearing habitats with respect to juvenile salmon and wetlands are not presented in the Assessment.
- The assessment of roads and culverts is incorrect because:
  - Current culvert standards are not adequately considered
  - Published culvert failure rates are not relevant.
  - Current road standards are not adequately considered.
  - Although some wetlands will be filled or altered, the Pebble road alignment has been carefully planned to avoid or minimize these impacts, especially as they might affect fish or fish habitat.
  - The existing (and proposed) road alignment is not parallel to or in close proximity to that portion of Chinkelyes Creek to which sockeye (or any other) salmon currently have access.
  - The responses of salmonids to culverts are not uncertain; there are thousands of examples of the effects of culverts on salmonid fish passage in the Western U.S. and Canada alone.
  - Much of the stream lengths upstream of the road are poor habitat or nonhabitat for salmon.
  - $\text{CaCl}_2$  is not toxic.
- General hydrological comments:
  - The sustainability boundary method should not be used because it does not use relationships between biota and flow that are specific to the site.

- Other methods for evaluating effects of streamflow regulation should be considered including: 1) Tennant/Montana Method, 2) Tow Width Method, 3) Wetted Perimeter, and 4) IFIM/PHABSIM.
- Hydrologic analyses need to include sources of data, specific location of gages used, and more description in the methods.
- The Assessment does not account for the reduction in evaporation due to the removal of vegetation and the duff layer that exists in the pre-mine condition. This would likely result in lower evaporation losses.
- Mean annual flow is absolutely meaningless from an ecological perspective as related to fish production.
- Section 5.2 attempts to quantify the impact that development may have on streamflow rates, but later acknowledges that it's not feasible to do so accurately.
- The river continuum concept should not be applied to Alaska because it was developed in a different type of river.
- Independent modeling indicates that the average annual alteration of stream flow estimated in the Assessment is supported by a more comprehensive model. However, consideration of temporal patterns of precipitation and climate suggests that hydrologic alteration would vary through the year, with short-term reductions in stream flow that greatly exceed the average reduction on an annual basis.
- General comments concerning fish:
  - Chum salmon do not rear in streams or rivers.
  - The assessment should explain why aerial counts are thought to underestimate the total run sizes.
  - There is no information regarding the genetics of the anadromous populations near the proposed mine site.
  - Spawning distribution maps do not match interactive maps from the Anadromous Waters Catalogue for Kaskanak and Upper Talarik, at a minimum.
  - The EPA should have evaluated the quantitative data presented at a Fish Technical Work Group meeting in 2008 and information from the 2004 Annual Progress Report for Fish and Aquatics for Northern Dynasty but not included in the Pebble Limited Partnership Environmental Baseline document.
- Assessment overestimates effects because in many instance EPA chose the most conservative measure, data, counts and indexes to determine potential impacts.
- Assessment should determine an average mine incident rate from other mines and violation records.

- Assessment should consider probable impacts of development on recreational fisheries and hunting.
- Assessment should include examples of large hardrock mines with wetland, stream, and fisheries impacts, especially if those impacts have been benign or offset by compensatory mitigation.
- Macroinvertebrate drift may not be diminished by the mine footprint.
- It is inconsistent to say that import of marine nutrients is important to the watershed and that export of nutrients from headwaters is important to downstream ecosystems.
- The length of streams lost in the mine footprint should be compared to the total length of streams in the entire watershed.
- The statement that “Projecting specific mining-associated changes to groundwater and surface water interactions in the mine area is not feasible at this time.” is inconsistent with the conceptual model which shows that reduced groundwater input would be expected to increase summer temperatures and decrease winter temperatures.
- Discuss how water treatment would affect water quality even if it does not fail.

#### **Chapter 6. Risk Assessment: Failure**

- Comments about failures in general:
  - Assessment consistently underestimates and understates likelihood of failures and maximum impact expected under worst-case failure scenario.
  - Because size of mine resource is underestimated, the Assessment underestimates long-term risks to fish.
  - Assessment excluded some failures that were considered beyond scope: chemical spills, fuel spills, tailing slurry pipeline failures, rock slides.
  - Assessment should consider performance record of existing mines, including historical record of mine effects estimates and compliance issues.
  - Assessment confuses salmonids vs. salmon; because many salmonid taxa were not considered, threats to salmonids are greater than assumed in assessment.
  - Conclusion on failure rates is not supported by review of historical and currently operating mines, and is in contradiction to Alaska’s record.
  - It should not be assumed that a reduction in salmon quantity or quality would affect salmon-based cultures. Mitigation should be assumed.
  - By placing doubt on the ability to operate in perpetuity, the Assessment creates an unrealistic standard that is impossible to meet.
  - Current mining practices such as those at the Red Dog mine are not appropriate representations of the potential for failures at the Pebble site.

- The assessment neglects to account for continuous improvement in technology to mitigate failures.
- The use of events at the Gibraltar mine and Nixon mine as examples represents a bias.
- The statement that a small fraction of Native Alaskans would be employed by the mine is incorrect.
- Tailings dam failure comments:
  - Impact of a major tailings pond failure is overstated, because immediate remediation is required under both state and federal law.
  - Current regulatory practice does not require financial assurance to cover dam failures or cleanup; securing such funding requires litigation and/or taxpayer support.
  - Dam maintenance will need to succeed for tens of thousands years, rather than hundreds.
  - Dam failure scenarios not realistic because:
    - The assessment examines scenarios where dams are not built to specification, which is not possible.
    - Examples of tailings spills include mining in the late 1800's and do not consider regulatory and engineering changes.
    - None of the examples are relevant to the regulatory and construction techniques expected to be applied.
  - Assessment's use of the Mt. St. Helens eruption as an analogy to a tailings dam failure is unrealistic and unscientific.
  - Mt. St. Helens demonstrates the resiliency of natural systems and potential for rapid recovery.
  - Dam failure could affect estuarine ecosystem, which should be addressed.
  - Risks of tailings storage facility (TSF) failure are underestimated by a factor of 10.
  - Experience with other tailings spills indicate that the run-out distance would be much greater than the 30 km modeled by the EPA. Based on the run-out model by Rico et al. (2008), it would be about 460 km for the partial-volume failure and about 1800 km for the full-volume failure.
  - TSF failure should be modeled for entire length of river to sea.
  - TSF failure should model a 38% or 50% release rather than 20%.

- Lack of fish assemblage and population data severely limits model accuracy and likely produces gross underestimates of fish effects.
- Minimum effect levels for fine sediments may be 3-5%.
- Only one kind of dam failure is considered; if considered other types of failures, overall rates would increase.
- Assessment should model a 30-day precipitation period of 1 inch per day on saturated soils, as this may be a more common event.
- The HEC-RAS model is applicable and its limitations are appropriately presented.
- The analysis of effects of a tailings spill on wildlife is inadequate.
- Aside from some local scour that may occur in the immediate vicinity of the embankment, no scouring of the existing bed or valley bottom would be possible from a tailings spill.
- Tailings transport and deposition could not affect salmon use of the Mulchatna and Stuyahok Rivers.
- None of the causes of tailings dam failures listed in the ICOLD review are possible at the Pebble site.
- Tailings dams located 100 to 275 miles from earthquake epicenters did not fail during quakes.
- By providing specific analytical model results to describe the tailings flow distance and associated sediment deposition from a hypothetical tailings release, the Assessment dam breach analysis appears credible whereas in fact, the analysis is flawed.
- The choice of a value for Manning’s friction factor is not adequately justified.
- The 30 meter digital elevation model is too coarse.
- The lateral extent of the cross-sections in the HEC-RAS model were likely insufficient.
- The extent of the sediment transport model should be extended to the river reach where the mine tailings are expected to be transported downstream (e.g. beyond the 30 km marker at the confluence of the North and South Koktuli Rivers).
- While the Hjulstrom curve is a widely used reference to evaluate sediment transport in streams, it is not well-equipped to be used to evaluate sediment settling in a dense, mostly solid flow such as the scenarios set forth in the Assessment.

- The contributing watershed area to TSF 1 is incorrect and this influences the comparative statistics.
- Ice scour and plowing should be included.
- The dilution of pore water by fresh water during a tailings spill would be trivial.
- Based on analogy to the Gibraltar mine, tailings pore water would not be toxic to fish.
- The fate of tailings in the Clark Fork River, Coeur d’Alene River and Soda Butte Creek is not relevant because the sources were different.
- The discussion of copper leaching from tailings does not quantify the dilutions in the receiving streams.
- The mobilization of metal enriched tailings by floods in the Coeur d’Alene River should not be mentioned because Cu was not a major toxicant.
- The analysis of dietary copper toxicity is incorrect because copper is a micronutrient and is well regulated.
- The persistence of metals in sediment depends on the metal.
- The dietary chronic value for rainbow trout from the Pellston Workshop proceedings is biased.
- Pipeline failure comments:
  - Two-minute pipeline shutdown is reasonable only if safety measures work as designed. Evaluate scenario using data on average actual shutdown time, if available, as well.
  - Product concentrate spills would be remediated.
  - Threat of spills to Iliamna Lake nearshore spawners, zooplankton, and phytoplankton should be better considered.
  - The published histories of pipeline failure are not relevant.
  - The assumption of a constant pipeline failure rate is inappropriate.
  - In the product pipeline failure scenario, the assessors should assume more closely spaced shut-off valves at the locations of failures.
- Water collection and treatment failure comments
  - Assessment should better acknowledge high magnitude of water management challenges and potential for water management failures.
  - The assessment does not distinguish short term failures of water collection and treatment from those that would have significant off-site effects.

- Text box 4-1 aggregates multiple worst-case failure scenarios into a single release event scenario which unreasonably overstates the probability of release due to a system failure in the water collection and treatment system. [NOTE: Actually, this box relates PLP’s geochemistry results to potential on-site processes, and does not present failure scenarios.]
- Significant water collection and treatment failures will not occur because of good management practices, if a reasonable time frame is considered (i.e., not perpetuity).
- Passive management may be sufficient post-closure.
- Failure of tailings leachate collection is unlikely and would be insignificant if it occurred.
- The sorts of water treatment failures that are common are unlikely to have significant effects.
- Inadequate designs of water treatment systems could no longer occur due to modern process engineering.
- Assessment evaluates water quality and hydrologic impacts during average flow conditions, but because degree of dilution from receiving waters will vary seasonally, assessments based on averages are almost certain to underestimate water quality impacts under low flow conditions.
- Independent modeling estimated that risks associated with failure of leachate collection from waste rock could include copper toxicity above water quality standards downstream at least to the middle Upper Talarik Creek, and to the junction of the North Fork and South Fork Koktuli rivers.
- Culvert and road failure comments
  - Likelihood of failures at stream crossings are greater than presented, because streambeds and wetlands are less stable than rock and more affected by floods.
  - Modern culvert designs prevent failures.
- Unless evidence suggests otherwise, extent of wetland area, stream length, and salmon occupancy should be assumed to extend to the entire area.
- Statement that PLP’s EBD describes broadly similar aquatic macroinvertebrate communities consistent with those reported from other regions of Alaska is incorrect, because they document taxa that have never been documented in Alaska.

## **Chapter 7. Cumulative and Watershed-Scale Effects of Multiple Mines**

- The document should not discuss cumulative impacts with specificity from unproven resources (e.g., Humble, Groundhog).
- There has been no exploratory drilling at Groundhog.

- The potential tailings dam location at Humble is misleading, because no mining company would place tailings on top of high-value salmon-bearing waterways such as Napatoli Creek.
- Assessment should consider the effects of infrastructure development and development of a mining district (increased impervious surfaces, legal and illegal take of fish and wildlife, litter, water use and contamination, interference with subsistence uses).
- Cumulatively there is a considerable underestimation of risks, given multiple TSFs.
- Assessment should provide, at minimum, a best and worst case range.
- Assessment should address the ways in which the nature of cumulative effects (inherent complexity and uncertainty) typically is used to avoid responsibility, delay redress, and further increases losses of fishery resources.
- Assessment states that other mines will have similar risks to Pebble, but this is unlikely since the other mines would be much smaller.
- Assumes that multiple mines will jointly use facilities, which may not be valid.
- Box 7-1 is not entirely accurate and should be revised to reflect the full complexity of the Fraser River sockeye run decline.
- Expand discussion of Fraser River as highly developed system that supports robust fisheries, and stress that because Bristol Bay will never be developed to the same extent, we can ensure that Bristol Bay can be developed sustainably.
- Assumption that other large scale mines would look the same as the hypothetical scenario and have similar impacts is flawed, due to differences in site-specific conditions resulting in different site designs.

## **Chapter 8. Integrated Risk Characterization**

- Assessment should include statements about general quality of mine waste leachate, based on EBD leachate tests.
- Lack of fish population modeling limits what assessment can really say about how any mine or mines might affect fisheries.
- Assessment should not over-simplify the system or analyses just to make it easier to understand or easier to complete. It should address more clearly that plan is to superimpose a complex facility and its operations on multiple, complex and poorly understood fish populations.
- Assessment provides a starting point, for beginning to analyze the full suite of potential impacts (considered and not considered) will interact in perpetuity.
- Potential habitat and water quality effects displayed in the conceptual diagrams and outlined in the risk assessment would be long-term continuous impacts, not independent data points.
- Assessment fails to consider socio-economic impacts to local communities, such as increased inflation, increased demand in services, increased social problems.
- Assessment mostly fails to draw connection between potential environmental impacts from large-scale mine development and important socio-economic impacts to local communities.
- Assessment underestimates impacts to wildlife



- Should emphasize how loss of salmon will impact wildlife as food and nutrient source.
- Should consider how transportation corridor will impact wildlife movement.
- Assessment should stress the certainty with which local residents would be culturally impacted if fish are impacted.
- Assessment should explain that all of the described effects would be mitigated.
- The streams and wetlands on the site are insignificant due to low productivity.
- Reconsider assertion that failure of one dam would relieve pressure on others.  
[NOTE: In Assessment, statement refers to multiple dams on a given TSF during a single event.]
  - Consider that “patched” dam would likely have less structural integrity than original and have lower elevation (i.e., that of remaining tailings).
  - Unclear how to quantify any “pressure relief” in failure statistics.

#### **Appendix A. Fishery Resources of the Bristol Bay Region**

- This information should not be used because the data are not publicly available or relevant.

#### **Appendix B. Characterization of Selected Non-Salmon Fishes Harvested in the Fresh Waters of Bristol Bay**

- This information should not be used because the data are not publicly available or relevant.
- Provide data used to identify/assess “key” fish habitat conditions (e.g., elevation, slope, groundwater).

#### **Appendix C. Wildlife Resources of the Nushagak and Kvichak River Watersheds**

- Underestimates impacts to wildlife:
  - Should emphasize how loss of salmon will impact wildlife as food and nutrient source.
  - Should consider how transportation corridor will impact wildlife movement.
- Provide data used to characterize wildlife habitat and distribution

#### **Appendix D. Ecological Knowledge and Cultures of the Nushagak and Kvichak Watersheds, Alaska**

- Commercial fishing no longer provides enough money to supplement a subsistence way of life, and additional employment is needed.
- Population is not stable; the Lake and Peninsula Borough has lost over 18% of its population since the 2000 census, and schools have been lost in Ivanof Bay and Pedro Bay due to low enrollment.

- Does not address a discussion of extremely sophisticated “ethnohydrology” of Dena’ina and other Northern Athabascan languages.
- Should emphasize disparity between locally reported ethnographic research materials, since the Pebble deposit is at the Yupik-Dena’ina interface (source materials for Dena’ina are vastly superior to those for the Yupik).
- Fails to consider socio-economic impacts to local communities, such as increased inflation, increased demand in services, increased social problems
- Could elaborate on relationship between subsistence and economics (e.g., money to purchase technology and supplies, money to replace subsistence harvests).
- Fails to consider harvest amount and composition of community harvest over time, to illustrate the potential seriousness of variation in the amount of or access to other subsistence resources.
- Importance of subsistence in social relations should be discussed further.
- Tanalian Inc. (Port Alsworth) is not a federally recognized tribe; the assessment should not treat it as such.

#### **Appendix E. Bristol Bay Wild Salmon Baseline Levels of Economic Activity and Values**

- Includes author-selected quotes by anti-mining residents that introduce bias into the report.
- Assessment did not quantify impacts to Native cultures, and should impacts beyond risks posed by potential declines in fish and wildlife.
  - Assess what will be left of these cultures after the “boom-bust” cycles associated with a mining based market economy, based on what has occurred in other areas.
- Original economic research should be conducted if economics will guide decision-making.
- Make material clearer for a lay person or public policy-maker.
- Appendix does not meet requirements of using accurate and professionally-defensible data, based on generally accepted and clearly articulated research and modeling techniques.

#### **Appendix F. Biological Characterization: Bristol Bay Marine Estuarine Processes, Fish and Marine Mammal Assemblages**

- Should be expanded to include importance of Bristol Bay as rearing habitat.

#### **Appendix H. Geologic and Environmental Characteristics of Porphyry Copper Deposits**

- The characterization of ABA results in Appendix H should be reevaluated to consider that neutralization potential may be overestimated.
- Statements that Tertiary rocks have no acid generation potential or no pyrite are not supported by the available data.

- Figures 7 and 8 are described as portraying the range of potential compositions of Pre-Tertiary and Tertiary waste rock seepage and tailings water, but they use average concentrations.
- Address fact that block caving would fracture overlying strata, allowing water and oxygen infiltration into mine. After closure, such infiltration could lead to down-gradient contamination.
- Presence of pyrite in Tertiary rocks means they would not be “lacking [in] sulfide minerals” and would require assessment for and treatment as potentially acid-generating material.
- Since zinc not present in economically recoverable quantities, it would remain in tailings and waste rock, potentially accessible to leaching with residual copper, with which it is synergistic as an ecological stressor.

## **Appendix I: Conventional Water Quality Mitigation Practices**

- Section 1 Waste Rock
  - More recent evaluation of acid generating potential than cited is more conservative (i.e., potential exists between NP:AP ratio 1 and 2, instead of 4).
  - Concerned that does not address continuing problems with acid rock drainage, even with new mines.
- Section 1.1.1 Operational Phase
  - Primary purpose of waste rock pile cover is to minimize infiltration, not to provide erosion protection or restore site.
  - Sub-economic ore can be the most problematic waste and is often not processed.
- Section 2.1.1 Tailings - Operational Phase
  - Zinc and lead typically are not mined from porphyry deposits; would be more correct to reference molybdenum, instead.
  - Meeting a limit on cyanide concentrations in TSFs and other open water facilities can be significant consideration not only in gold operations, but also when it is part of pyrite suppression.
- Section 2.2 Accidents and Failures
  - Use of unstable (when saturated) tailings for upstream dam construction is a greater threat than use of coarse tailings material.
- Section 10 Compensatory Mitigation
  - Compensatory mitigation in Bristol Bay will probably center on whether it is possible to restore salmon habitat and/or enhance fisheries through hatcheries, stream improvements, etc.
- Zinc and lead porphyry deposits do not exist.